Observing Cold Dust with Herschel / SPIRE

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Abstract. A major component of the emission of many galaxies is in the Far Infrared and the Submmillimeter. UV photons from stars are absorbed by dust and re-emitted at longer wavelengths. Fairly cold dust was found in large spirals by the Infrared Space Observatory and the Spitzer Observatory, but their longest wavelength filters were centered at 200 and 160 microns respectively, restricting detection to dust warmer than about 15 Kelvin, and missing a major part of the dust mass. The Spectral and Photometric Imaging Receiver SPIRE ([1]) is one of the 3 instruments on board of the Herschel Space Observatory that was launched on 14 May 2009. The instrument hosts bolometer arrays with broadband photometric filters, centered at 250, 350 and 500 μm, as well as an imaging Fourier Transform Spectrometer, covering the range from 200 to 670 μm at 3 different spectral resolutions. This long wavelength coverage will, among many other subjects, allow for studies that take the entire dust content of a galaxy into account. The 3 instruments of Herschel are currently undergoing performance-and science-verification operations, followed by the execution of the first large key science programs. A call for smaller open time programs is expected to be issued after the science verification phase is complete.

SPIRE is designed primarily to exploit Herschel's capabilities in addressing two of the most prominent questions of modern astrophysics:

- How and when did galaxies form? - The investigation of the statistics and physics of galaxy and structure formation at high redshift;
- How do stars form? - The study of the earliest phases of star formation, when the protostars still coupled to the interstellar medium.

These investigations require the ability to carry out large area deep photometric imaging surveys at far-infrared and submillimeter wavelengths, and to follow up these observations with spectroscopy of selected sources. SPIRE will exploit the unique advantages of Herschel: its large-aperture, cold, low-emissivity telescope; the complete lack of atmospheric emission giving access to the poorly explored 200-670 μm range, and the large amount of high quality observing time. Because of these advantages, SPIRE will have unmatched sensitivity ([2]) for deep photometry ([3]) and moderate-resolution spectroscopy ([4]). As an example Figure 1 shows a 2 by 2 degree map of part of the outer galactic plane that was taken by the SPIRE consortium during the Performance Verification Phase.

Although SPIRE has been optimized for the two main scientific programs, it will offer the astronomical community unique observing capabilities to tackle many other astrophysical topics: giant planets, comets, the galactic interstellar medium, nearby galaxies, ultraluminous infrared galaxies, and active galactic nuclei. Its capabilities will

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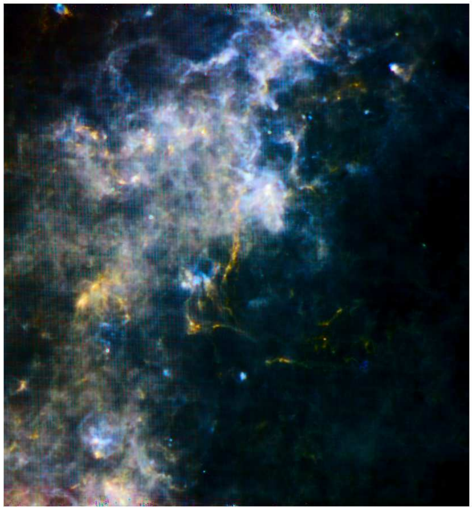

FIGURE 1. SPIRE map of a part of the outer galactic plane.

remain unchallenged by the ground based and the airborne observatories which are planned to come into operation over the next decade.

More information can be found at the web sites of the Herschel Science Center: `http://herschel.esac.esa.int/home.shtml` and of the NASA Herschel Science Center: `http://www.herschel.caltech.edu/`.

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